MARKETS AND BUSINESS STRATEGY

THE CLEAN DEVELOPMENT MECHANISM
A REVIEW OF THE FIRST
INTERNATIONAL OFFSET PROGRAM

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Executive Summary

The Clean Development Mechanism (CDM), established under the Kyoto Protocol, is the primary international offset program in existence today, and while not perfect, it has helped to establish a global market for greenhouse gas (GHG) emission reductions. It generates offsets through investments in GHG reduction, avoidance, and sequestration projects in developing countries. The United States is not party to the Kyoto Protocol, but was instrumental in negotiating the treaty and championing market mechanisms as a way to achieve the targeted reductions at lower cost. The CDM has managed to establish—in its relatively short eight years of existence—a credible, internationally-recognized, $2.7 billion carbon offset market with participation from a large number of developing countries and private investors. It has also created processes and methodologies that other programs are already emulating.

A vast amount of work and investment—by participating countries, the private sector, and the United Nations Framework Convention on Climate Change (UNFCCC) secretariat—have gone into developing the CDM's rules, procedures, and institutional structures. The creation and rapid growth of a large and unprecedented international program, however, has not been without its challenges or controversies. Issues have been raised regarding the governance of CDM, the quality of approved projects, and the contribution of CDM to sustainable development. Concerns about these issues have fueled a strong debate among U.S. policy analysts about the ability of the CDM to deliver emission reductions of sufficient quality and quantity, and the role for international offsets in any future U.S. policy framework.

Economic modeling by the U.S. Environmental Protection Agency (EPA) and the U.S. Energy Information Administration (EIA) demonstrates the importance of international offsets in lowering the cost of U.S. emission reductions. Emission reduction projects in the developing world, such as those undertaken through the CDM, have the potential to be some of the lowest cost reduction options globally. Yet, these lower costs can only be realized if the transaction costs associated with administering an international offset program like the CDM are kept to a minimum while simultaneously ensuring high quality emission reductions.

This paper outlines a set of principles for ensuring high-quality offsets, examines the CDM against these criteria, and reviews lessons learned, institutional changes that have been made, and the ongoing challenges.

To maximize both its environmental and economic benefits, a GHG offset must be:

1. **Additional**—projects should result in emission reductions relative to a credible baseline that would not have occurred were it not for the existence of the incentive provided by the offset program.

2. **Measurable**—monitoring of emissions and calculation of emission reductions must be verifiable and based on credible data.

3. **Independently audited**—the eligibility of projects and accuracy of emission reduction calculations should be reviewed by expert auditors with no conflicts of interest.

4. **Unambiguously owned**—rights to the credits should be clearly based on domestic and international law and emission reductions must not be double counted.

5. **Able to address/account for leakage**—all emission sources impacted by the project should be accounted for, including those outside a project's boundary.

6. **Permanent**—credits should represent a permanent removal of GHGs from the atmosphere, and in project types where a reduction could be reversed (e.g., afforestation), there must be a way to account for non-permanence.

An apt characterization of the CDM to date would be "learning by doing." This has been driven in part by the need to quickly operationalize a system capable of delivering credible offsets for the first Kyoto commitment period (2008 through 2012). Debating and developing every methodology and procedure before launching the program would likely have delayed the program for years. Our assessment of the CDM's performance to date indicates, first, that the early focus on expediency resulted in the creation of a global GHG offsets market in a surprisingly short period of time, and second, that the CDM was designed with the flexibility to adapt with experience, which it has done and continues to do.

The downside of "learning by doing" is that naturally a variety of problems have surfaced. With only limited technical guidance in the early stages, project developers, auditors and even UNFCCC staff struggled with issues like additionality, leakage, measurement, and auditing. Consequently, it is very likely that some non-additional projects were initially registered and some early versions of methodologies were approved without full testing. The CDM Executive Board has since sought to address deficiencies and strengthen practices. Guidance documents and Board decisions are now more fully developed and widely available. The Board has also added staff and review teams to better evaluate and ensure the quality of projects before registration. Over the last two years, third-party auditors have also come under increased scrutiny and the

Board has sanctioned several companies. In general, the trend towards more rigorous project review, increased standardization for additionality and baselines and more auditor oversight is very encouraging.

Going forward, Kyoto Protocol parties and the Board are discussing further changes and reforms to increase standardization, extend CDM into countries not yet benefiting from it, and, most importantly, increase its efficiency and scale. GHG offsets will also continue to play a role in negotiations over the future of the global climate effort. As capacity builds in both the public and the private sectors of developing countries, access to GHG markets may serve as a potential bargaining tool for developed countries, such as the United States, who could be large buyers of credits. Developing countries may be more willing to accept some form of longer-term commitment to limit emissions in return for market access in the short term.

After years of investment, the institutional apparatus of the CDM is fully operational and widely supported by industry and the international community. Currently, no alternative institutional structure exists with a similar potential, and the creation of a new international offset system would most certainly require years of learning and adjustment.

I. Introduction and Context

In response to the changing climate, many U.S. states and the Federal government have been debating policy mechanisms to advance clean energy technologies and reduce greenhouse gas (GHG) emissions both domestically and internationally. One of the central topics over the past several years has been how and whether to design a market for GHG emissions. In designing a market-based policy program, legislators have had to grapple with a number of key questions, such as the targets and timetables for reducing emissions, the sectors of the economy that should fall under the emissions limit, and the mechanisms for containing the costs of the program.

As has been shown in a large number of studies, an emissions market is a cost-effective policy tool for mitigating GHG emissions, as it encourages the lowest cost reductions to occur first. However, not all GHG sources can be effectively covered by the program. Some individual sources are small (e.g., in agriculture), others lack good data or are not easily measured (e.g., coal mine methane), and still others may be more effectively dealt with through other policies (e.g., building energy efficiency). Including these types of sources in an emissions market could create excessive administrative burden and significantly raise overall program costs. Some of these emissions, however, can be integrated into the program by addressing them as emission offsets (also commonly called carbon offsets or offset credits). An emission offsets program can send a price signal to these smaller sources, encouraging innovation, incentivizing emission reduction activities, and perhaps providing the foundation for broader and deeper emission reduction policies in the future.

The Clean Development Mechanism (CDM), established under the Kyoto Protocol, is the primary international offset program in existence today. It generates offsets through investments in GHG reduction, avoidance, and sequestration projects in developing countries. These offset credits, called Certified Emission Reduction credits (CERs), represent a reduction in one metric ton of carbon dioxide (CO_2) emitted to the atmosphere.[1] Developed countries can use CERs to more cost-effectively achieve their Kyoto Protocol GHG emission reduction targets. While the United States is not a signatory to the Protocol, several U.S. state GHG programs, including the Regional Greenhouse Gas Initiative and the Western Climate Initiative, have also proposed that CERs be used in their programs by firms for compliance purposes.

Apart from providing a cost-containment mechanism for developed countries to meet their Kyoto Protocol emission reduction targets, the CDM may play a critical role in providing private sector financing for low carbon technology in developing countries. At the 2009 Climate Conference in Copenhagen (COP 15), U.S. Secretary of State Hillary Clinton pledged that developed countries would mobilize $100 billion by 2020 from both public and private sources for climate mitigation and adaptation in the developing world. The CDM has already channeled $2.7 billion[2] of private sector financing to developing countries, and there is the potential that the United States and other developed countries can capitalize on this experience to help meet the $100 billion goal.

This paper examines the primary issues, successes, and challenges of the CDM to date. After this introduction and a brief introduction to offsets, section II reviews the market mechanisms found in the Kyoto Protocol and the CDM's structure and processes. Section III follows with an overview of the CDM market and its role in emissions trading cost containment. Section IV turns to an in-depth review of how offset quality is determined under the CDM, including an analysis of the processes, concerns, and lessons learned for the critical criteria of additionality, measurement, auditing, ownership, leakage, and permanence. Finally, section V addresses the implications of the CDM for developing countries with regard to technology transfer, impacts on sustainable development and capacity building, as well as the potential risk for creating perverse incentives.

A Brief Introduction to Offsets

In the context of a cap-and-trade program, a GHG offset represents a reduction, avoidance, destruction, or sequestration of GHG emissions that is from a source not covered by an emissions cap or another emission reduction requirement. These offsets can then be used to meet an emissions reduction objective or requirement of a covered source or entity. In other words, provided that the reduction meets the established offset eligibility criteria, the purchasing firm or country is allowed to meet its compliance obligation as though it had either purchased an emission allowance or made the reduction itself. The essential promise of an offset is the achievement of a real and verifiable reduction in global GHG emissions beyond what would have occurred in the absence of the incentive offered by the offset program (which is equally as effective as an on-site emission reduction by a regulated entity).

Unlike other pollutants that have impacts proximate to their emissions source, GHGs accumulate uniformly throughout the earth's atmosphere. A ton of GHGs emitted in the United States has the equivalent impact of a ton emitted anywhere else in the world. Therefore, from a strictly scientific perspective, a ton of emission reductions has the same benefit regardless of its location, and analogously, the location of emissions is immaterial to its climate change impacts.

Fundamentally, an offset program allows emissions to be reduced at the lowest cost, without regard to the boundaries of the emissions cap. If designed well, offsets will lower the overall costs of meeting a domestic or international emissions target, while directing investments into economically, socially, and environmentally beneficial activities. This potential is especially large in developing countries, where there are many opportunities for achieving low-cost emission reductions (a McKinsey study estimates that 67 percent of the global GHG emissions abatement potential is in the developing world).[3] Along with reducing costs, offsets should be able to promote technology transfer and capacity building in sectors and countries not directly covered by emission reduction commitments (whether this is actually occurring requires further study).

II. The Kyoto Protocol Market Mechanisms & CDM

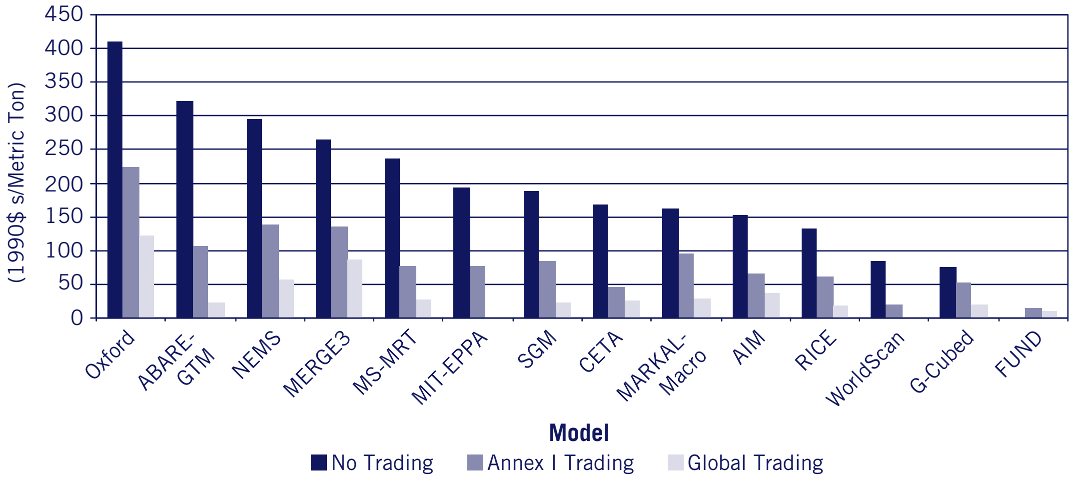
The Kyoto Protocol is an international treaty under the United Nations Framework Convention on Climate Change (UNFCCC) that sets binding GHG emissions targets for 37 industrialized countries and the European Community, which together are known as the Annex I countries.[4] These targets collectively amount to an average emissions reduction of 5 percent from 1990 levels over the five-year period from 2008-2012. The United States is not party to the Kyoto Protocol, but was instrumental in negotiating the treaty and championing market mechanisms as a way to achieve the targeted reductions at lower cost.

Market mechanisms and offsets were not new concepts to U.S. policy makers. The first application of a tradable offset was under the 1977 Clean Air Act (CAA).[5] The Act allowed a company to increase its emissions of a criteria pollutant if it paid another company to reduce, by a greater amount, its emissions of the same pollutant. In 1990, the CAA Amendments established an even broader market approach with cap-and-trade programs for sulfur dioxides (SO_2) and nitrogen oxide (NO_x) emissions from electric power plants.[6] These programs have proven successful, as emissions have been reduced both faster and at a considerably lower cost than was predicted or would have been possible through a traditional command-and-control regulatory approach.[7]

The success of these programs greatly influenced the United States during the negotiations of the Kyoto Protocol in 1997. To help developed countries more cost-effectively meet their emission targets, and to encourage the private sector and developing countries to contribute to emission reduction efforts, U.S. negotiators insisted that the Protocol include three market-based mechanisms: international emissions trading and two offset programs—Joint Implementation (JI) and the CDM.[8] Similar to a domestic cap-and-trade program between companies, international emissions trading enables the transfer of emissions "allowances," each worth one ton of GHGs, from one country to another while keeping the total amount of allowable emissions constant. JI allows companies or countries with emissions reduction commitments to fund specific emission reduction projects in other developed countries, and to credit the resulting emission reductions against their Kyoto obligations. CDM is similar to JI, except that the emission reduction projects must be done in developing countries. The primary function of these market mechanisms is to provide developed countries with flexibility on how to comply with their Kyoto Protocol emission reduction targets.

While it does not matter from an environmental perspective where GHG reductions occur, the location of a reduction has economic implications because companies and countries face widely different costs of controlling their emissions. Hundreds of analyses, using a wide array of economic models, conclude that the costs of achieving an emission reduction target are significantly lower if international emissions trading is permitted, rather than if each nation were to meet its emission reduction commitment domestically. A Pew Center study[9] found that widening the carbon market from U.S.-only ("No Trading" in Figure 1) to include other Annex I countries lowered the U.S. carbon price by a factor of two. Expanding the market to include developing countries as well ("Global Trading" in Figure 1) cut the U.S. carbon price by another 50 percent. In general, the broader the trading possibilities, the greater the chance of finding lower cost emission reduction options and the lower the costs of meeting a given target will be.

Figure 1. Estimated Year 2010 Carbon Price Needed to Achieve U.S. Target under Kyoto Protocol



Source: Weyant (2000) (based on EMF-16 results)

While there have been relatively few projects conducted under JI over the last ten years, a vast amount of work and investment—by participating countries, the private sector, and the UNFCCC secretariat—has gone into developing the CDM's rules, procedures, and institutional structures. This work, driven primarily by the demand for low-cost emissions reduction credits from the EU Emissions Trading System (EU-ETS), has resulted in the creation of a burgeoning global market for GHG emission offsets. Given the lack of precedent for such a large-scale offset program and the complexities of establishing an international market mechanism, the CDM's growth has been remarkable, from its first trade in 2005 to a liquid market for credits valued in 2009 at $2.7 billion.[10]

The creation and rapid growth of such a large and unprecedented international program, however, has not been without its challenges or controversies. Issues have been raised regarding the governance of CDM, the quality of approved projects, and the contribution of CDM to sustainable development. Concerns about these issues have fueled a strong debate among U.S. policy analysts about the ability of the CDM to deliver emission reductions of sufficient quality and quantity, and the role for international offsets in a U.S. policy framework. In order to evaluate these criticisms, it is important to first understand how the CDM works, as well as the current state of the CDM market.

CDM Structure and Process

The CDM Executive Board ("Board") is the chief regulatory body for the CDM. The ten members of the Board and their alternates[11] are elected by the Parties to the Kyoto Protocol and are governed by decisions of the Parties. The Board oversees the entire CDM process, from the project evaluation stage to the issuance of credits. Its responsibilities include:

- Assessing, approving, and registering CDM projects;
- Issuing CDM credits (CERs) to registered projects;
- Reviewing and approving new project methodologies (i.e., protocols related to the quantification of emission reductions);
- Adopting new CDM rules, guidance, and procedures, some of which need to be confirmed by Parties to the Protocol;[12] and
- Accreditation and supervision of independent project auditing firms.

The Board has established a multi-stage process in which projects are proposed by developers (from the private and/or public sectors) and then reviewed[13] at least twice before a decision is made. This decision could be either to approve, reject, or refer the project for further investigation. The work of the Board in reviewing and approving projects is supported by the UNFCCC secretariat, outside experts, and independent auditors, as discussed below.

Stage I: Project Design, Validation, and Registration

A project developer, which may be an individual or a company,[14] initiates a new CDM project by preparing a standardized proposal called a Project Design Document (PDD) (Figure 2). PDDs include detailed project information on technologies that will be employed, the expected environmental impacts, a calculation of the projected emissions with and without the project, and the approved methodologies to be used for monitoring and quantifying emission reductions from the project. Project developers have the option to either choose from one of the more than 140 approved methodologies in the CDM library or propose a completely new methodology. Newly proposed methodologies must undergo a thorough review process by the UNFCCC Secretariat, independent experts, a CDM methodology panel, and the Board before final approval.

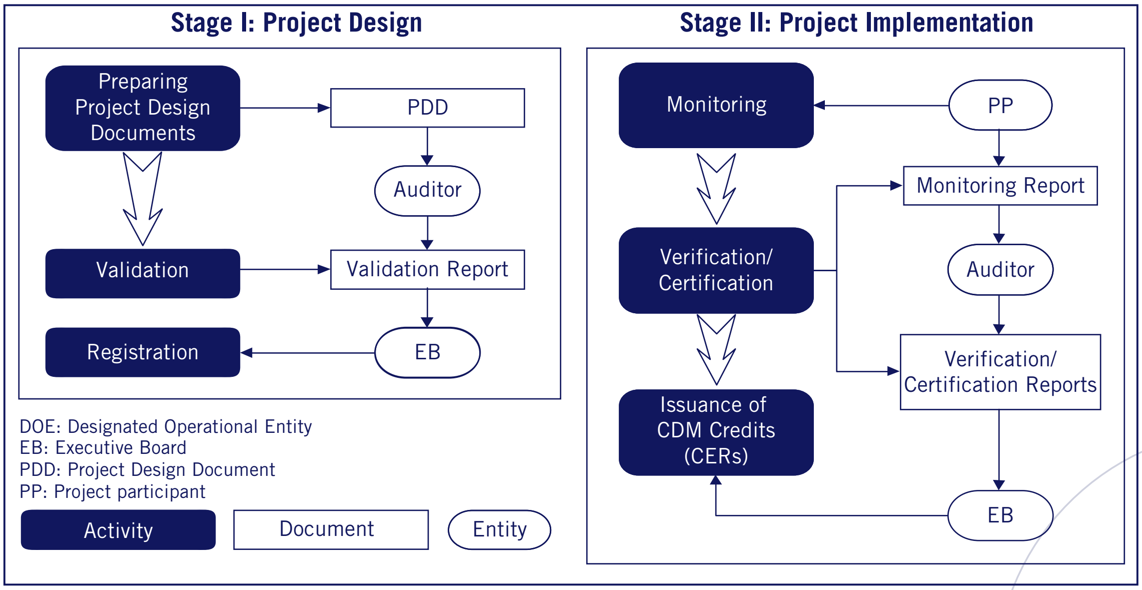
Once a PDD is completed, it is submitted to the host country's Designated National Authority (DNA), usually the Ministry of Environment, which is that country's central point of contact for CDM projects. The DNA reviews the proposed project and assesses whether it will contribute to national sustainable development goals, and if so, the DNA issues a Letter of Approval. The completed PDD must then be "validated," for which the project proponent must hire an accredited auditor, known as a Designated Operational Entity (DOE), to conduct an independent and thorough audit of the project proposal. These auditing firms are typically private companies that are judged capable of conducting credible and independent technical assessments of emission reduction projects.[15]

If the auditor deems that the proposed project meets all the CDM's requirements and is technically sound, the proposal enters a thirty-day public comment period where stakeholders such as non-profit organizations and the local community can provide input.[16] After stakeholder engagement, if the auditor is satisfied he submits a validation report certifying the proposed project is ready for formal review and registration by the Board. With the support of various technical teams, the Board assesses the proposal and validation report and can 1) reject the project; 2) call for it to be improved and re-submitted; or 3) approve it for registration. After registration, projects generally move forward for implementation.

Stage II: Project Verification and Issuance of CDM Credits

After the project has been operating and monitored for a certain period of time (typically one year),[17] the project developer is required to hire another accredited auditor (different from the one hired for the validation phase) to verify the amount of emission reductions achieved (Figure 2).[18] The project's monitoring reports and the auditor's verification reports are then submitted to the Board for approval. If each report is approved, CERs are issued to the project participants. A project must continue to submit monitoring and audit reports and credits are issued for the duration of its crediting period, which for most projects is either seven or ten years with the opportunity to apply for two seven-year renewals.

Figure 2. CDM Processes and Institutions



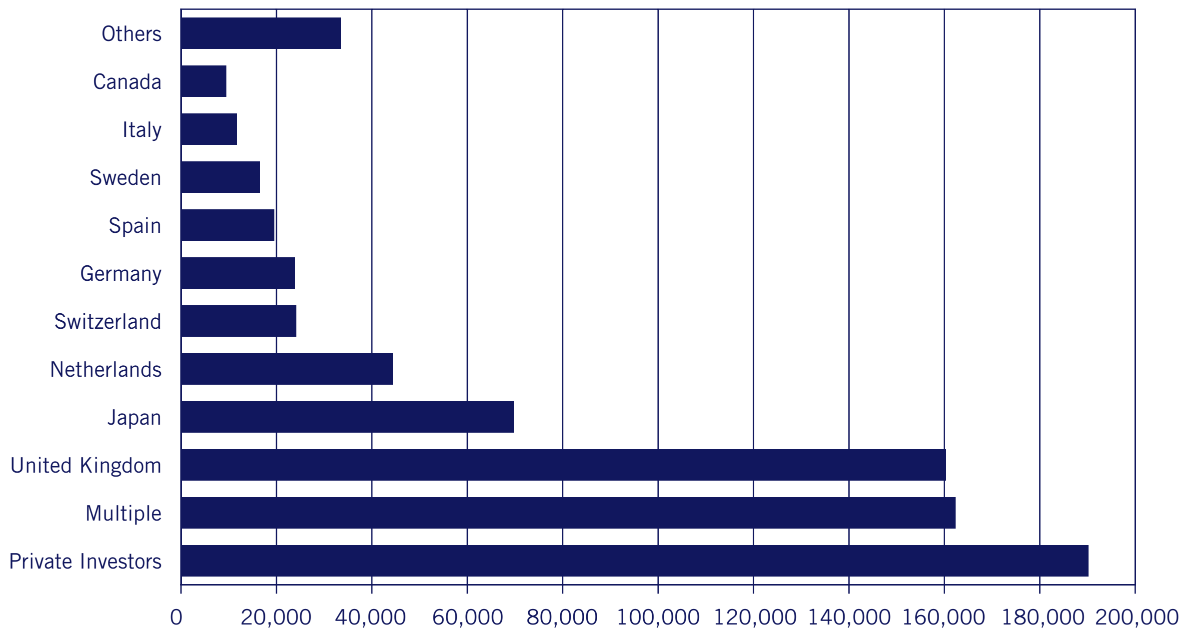
III. The CDM Market & Its Role in Cost Containment

CDM Market Characteristics

Since its beginning in 2005, the CDM has registered over 2,400 projects and more than 2,600 others are in the "pipeline" at various stages of project development. This figure has been rising on average by 125 projects per month.[19] It is anticipated that the registered projects will generate over 360 million CERs annually, or over 2.9 billion CERs during the first commitment period of the Kyoto Protocol from 2008–2012.[20]

CER prices are largely driven by demand from countries that have ratified the Kyoto Protocol and firms regulated under the EU-ETS, as well as "unilateral" project investors wishing to sell credits to these firms (Figure 3).[21]

Figure 3. Annual CERs Generated Through Purchase Agreements by Buyer Country

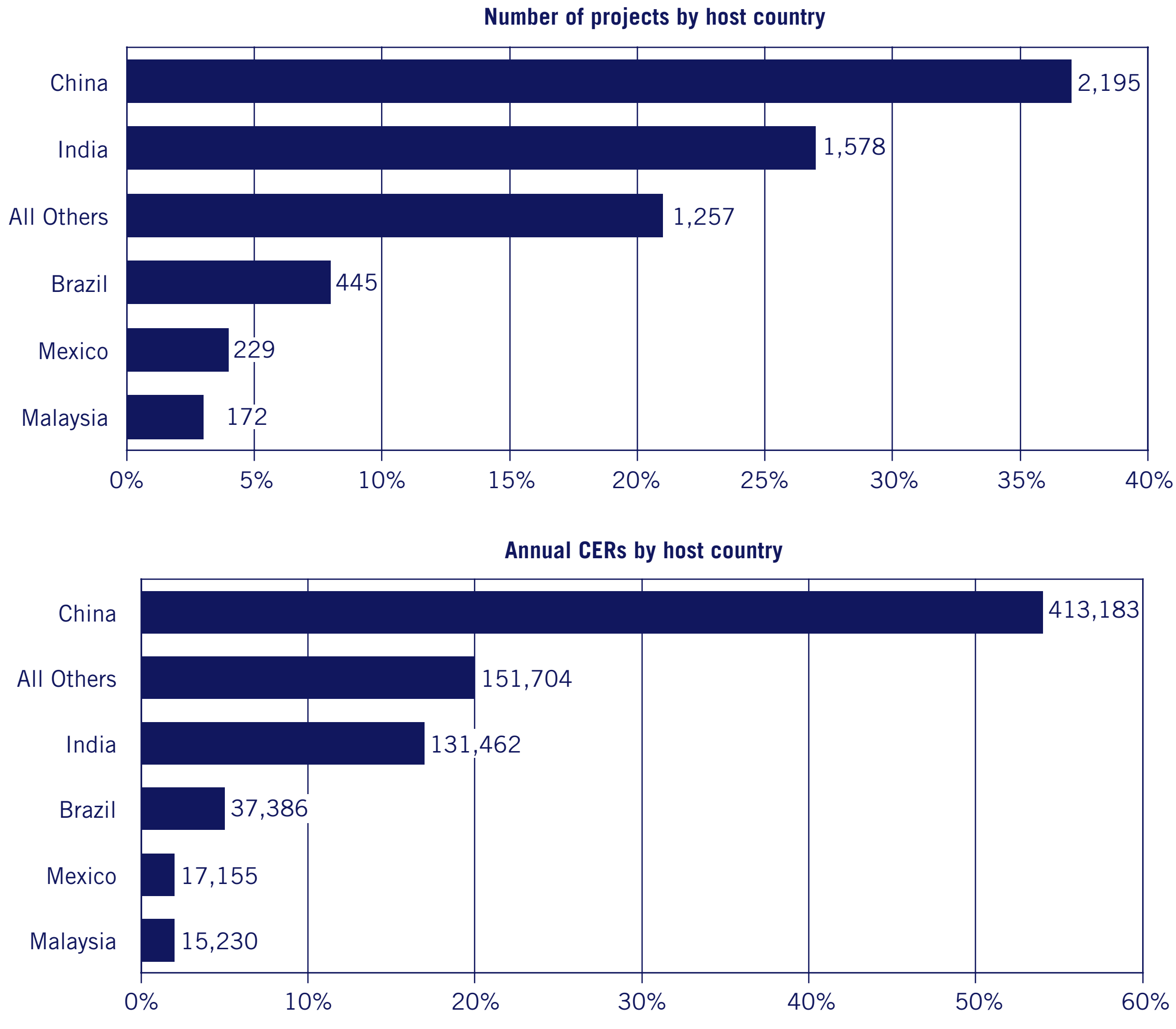


Source: UNEP Risoe (2010).

Note: "Multiple" includes partnerships of two or more countries purchasing CERs, or funds such as those managed by the World Bank's Carbon Finance Unit. "Private Investor" projects are those undertaken without advance purchase agreements by investors who do not have a predetermined buyer for the CERs generated. Data represents all CDM projects in the pipeline (i.e., at the validation, registration or issuance stages).

CDM projects are located throughout the developing world, with the majority of projects occurring in the largest developing economies. As of March 2010, there were more than 80 countries hosting projects, with China and India alone hosting a combined 63 percent of the projects and producing 71 percent of expected annual CERs (Figure 4).

Figure 4. Expected Number of CDM Projects in the Pipeline and Annual Average CERs by Host Country (2008–2012)

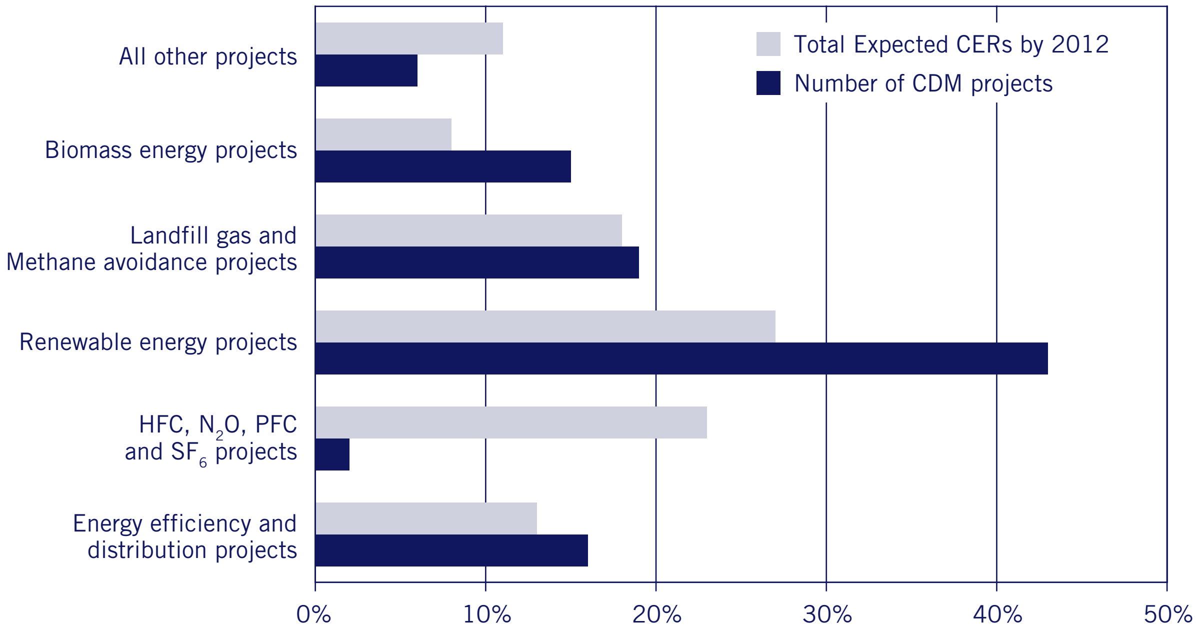


Source: UNEP Risoe (2010).

Note: Data represents all CDM projects in the pipeline (i.e., at the validation, registration or issuance stages).

While CDM projects are informally classified into 25 project types (see Appendix), there are few restrictions on the type of activity that may constitute a project, as long as it meets the CDM eligibility criteria. Renewable energy projects are the most common and account for 43 percent of CDM projects. (Figure 5). Cumulatively, 27 percent of emission reductions (CERs) from projects currently in the pipeline will come from renewable energy projects, such as hydro, biomass energy and wind, while 23 percent will come from industrial hydrofluorocarbon (HFC) and nitrous oxide (N_2O) projects, and 16 percent from energy efficiency projects (Figure 5).

Figure 5. Relative Number of CDM Projects and Expected CERs by Project Type



Source: UNEP Risoe (2010).

Note: Data is as of March 2010 and represents all CDM projects in the pipeline (i.e., at the validation, registration or issuance stages).

These projects have gone forward ultimately because there is a market and value for CERs. The price for a "secondary"[22] CER hit a high of $26 in July 2008, and then fell to around $10 in February 2009 in response to the global economic slowdown.[23] The price has since recovered somewhat and CERs, as of November 2010, were trading around $16. For comparison, EU allowances (EUAs) are trading at about $20, which is about 29 percent higher than a CER.[24] In fact, CERs often sell at a lower price, reflecting the lower costs of abatement and added project risks not relevant to government-issued EUAs. The expectation that emission reduction opportunities are cheaper in developing countries is often used as a justification for including international offsets in a U.S. cap-and-trade program.

The CDM's Role in Cost Containment

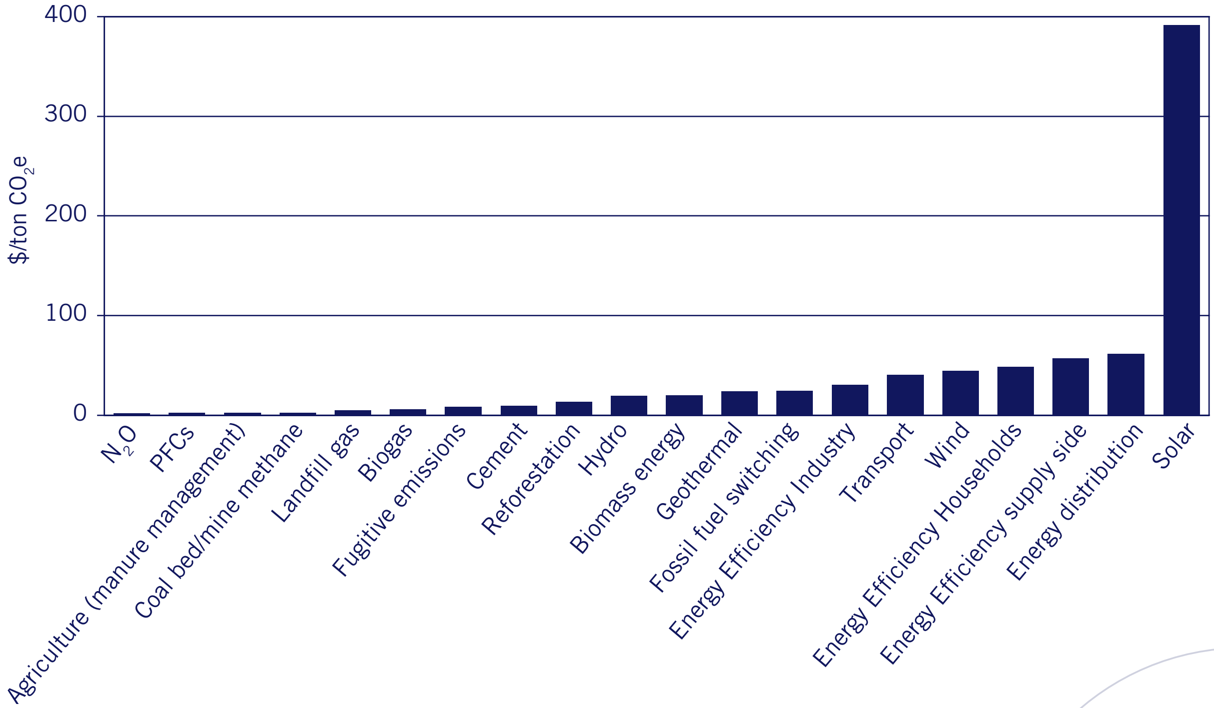
Economic modeling by the U.S. Environmental Protection Agency (EPA) and the U.S. Energy Information Administration (EIA) forecasts that as the use of offsets increases, the price of domestic emission allowances decreases. Analysis by the EPA of the Waxman-Markey bill passed in the House in 2009 (H.R. 2454) showed that if international offsets were not used, domestic allowance prices could increase by 89 percent.[25] More recent modeling done by the EPA in 2010 of the Kerry-Lieberman American Power Act concluded that without any international offsets, domestic allowance prices would increase between 34 and 107 percent, depending on the scenario considered.[26]

Because the CDM projects originate in the developing world, they have the potential to be some of the lowest cost reduction options globally. Yet, these lower costs can only be realized if the transaction costs associated with administering an international offset program like the CDM are kept to a minimum while simultaneously ensuring high quality emission reductions. This next section reviews both the cost of mitigation options available in developing countries and the transaction costs involved in bringing those emission reductions into the carbon market.

Low-Cost Mitigation Options in Developing Countries

There is no one best estimate for the cost of reducing emissions in the developing world, but the average annualized investment for specific project types provides a useful proxy for the cost per ton of reducing emissions in CDM projects (i.e., the dollars spent per expected CER). While the estimated investment under the CDM varies widely by project type, from $0.79/ton for N_2O projects to $391/ton for solar, it averages just over $25/ton across all project types (Figure 6).

Figure 6. Average Annualized Investment Costs of CDM Projects



Note: Data compiled by authors taken from CDM PDDs that report expected capital expenditures (i.e., expenditures on equipment, infrastructure, and engineering services). Data was collected from 5,001 CDM PDDs in the pipeline through 2009,[27] converted to U.S. dollars using an average exchange rate for the two first quarters of 2009, and expressed as annual investment (capital investment amortized over the project life span) per tCO_2e reduced. Capital costs were amortized over the expected crediting period of the CDM project. For projects with renewal crediting periods, the project was assumed to undergo two renewals to the maximum of 21 years. Funding for the data collection was supplied by the World Bank, Development Economics Research Group.

Although the investment cost variation among types of projects is significant, it is also somewhat misleading in terms of which project types offer the largest return on investment. For example, while solar projects represent the highest investment cost per ton, they also benefit from the additional electricity revenue generated (or avoiding the need to purchase electricity). Project types such as N_2O and HFCs, on the other hand, often see a return based only on the income from CERs.

Transaction Costs

Part of the direct investment cost of a CDM project is related to putting the project through the CDM registration process. Specifically, these costs include preparation of documents, validation and verification (auditing), registration,[28] and potentially developing new methodologies. If the administrative and other transaction costs associated with an international offset project are too high, they can outweigh any gains from the ability to capture lower cost emission reductions.

Wetzelaer, et al. in 2007 reviewed the CDM projects in the pipeline and determined that the transaction costs per ton were small—in the range of 0.05-3.5 percent of the CER price ($0.01 to 0.70 per CER).[29] Antinori and Sathaye (2007) reached similar conclusions, finding transaction costs for CDM projects ranging from $0.03 per CER for large projects to $4.05 per CER for smaller projects, with a weighted average of $0.36 across all projects. More recent data from the World Bank (2009) suggests that transaction costs, including project preparation costs, roughly range from $0.02 per CER for large industrial projects to $1.2 per CER for smaller projects.[30] These data demonstrate that the transaction costs can be relatively small.

The number of CERs that a project type generates significantly affects the relative transaction costs on a per-ton basis due to the presence of certain fixed costs. For instance, because HFC and N_2O projects reduce GHGs with high global warming potential, the number of credits generated are typically large and thus on a per-ton basis the transaction costs are smaller.[31] Minimizing these costs is important as they can be a barrier for project developers and thus dampen investment, especially for small projects. Transaction costs, however, are inherent in any offset program because of the essential requirements to measure, verify, and monitor emission reductions to ensure offset quality and ultimately program integrity.

IV. Assessing CDM Offset Quality

One of the fundamental considerations when evaluating the success of an offset program such as the CDM is whether the credits generated by the program meet well-accepted standards of offset quality. The first step in making such an assessment is to define the quality criteria against which the process and its projects can be evaluated.[32] This section defines these criteria, assesses the CDM against them, and then, where appropriate, discusses options for improvement.

With an aim to preserve the environmental integrity of a cap-and-trade system, a high quality offset must be:

1. **Additional**—projects should result in emission reductions relative to a credible baseline that would not have occurred were it not for the existence of the incentive provided by the offset program.

2. **Measurable**—monitoring of emissions and calculation of emission reductions must be verifiable and based on credible data.

3. **Independently audited**—the eligibility of projects and accuracy of emission reduction calculations should be reviewed by expert auditors with no conflicts of interest.

4. **Unambiguously owned**—rights to the credits should be clearly based on domestic and international law and emission reductions must not be double counted.

5. **Able to address/account for leakage**—all emission sources impacted by the project should be accounted for, including those outside a project's boundary.

6. **Permanent**—credits should represent a permanent removal of GHGs from the atmosphere, and in project types where a reduction could be reversed (e.g., afforestation), there must be a way to account for non-permanence.

1. Additionality

One of the most critical criteria for offset quality, and one of the most difficult to determine, is additionality. If a CDM project would have been implemented "anyway" regardless of whether there was any potential to earn offset credits, then the reduction should not be considered "additional." Because an offset credit is treated in a cap-and-trade program as though the purchasing entity had bought an allowance or made the reduction itself, the offset credit must represent a reduction that is beyond what would have occurred in a credible baseline scenario.[33]

Although the concept of additionality is not new to U.S. environmental or energy policies,[34] it is a difficult concept both to grasp and to apply in practice. Specifically, determining the additionality of a proposed project is challenging because:

- Project investments are typically made for a variety of reasons;
- Investors have an incentive to make whatever claims they think will convince program administrators to approve their project proposal; and
- Different administrators and auditors may interpret the evidence for additionality in different ways.

Auditors and program administrators have developed and applied techniques for many project types that attempt, through multiple tests and layers of review, to provide a reasonable approximation that the project provides "additional" emission reductions. Perfection, however, is neither realistic nor attainable. Many offset advocates have called for an improved process that minimizes both the number of non-additional projects that are mistakenly approved and the number of truly additional projects that are incorrectly rejected.[35] While better data, more refined assessment techniques and more thorough proposal reviews can all reduce errors, they can also increase the time it takes for project review, increase the administrative burden and raise the transaction costs previously discussed. Thoroughness and transaction costs thus must be carefully weighed to ensure that an offset program delivers the widespread incentives for emission reductions and low carbon technology deployment desired, while ensuring that environmental goals are met as well. The following section outlines the process currently used to assess additionality in the CDM.

The CDM Additionality Process

The CDM defines a project as additional if it passes a multi-step process[36] that determines if GHG emissions are below those that "would occur in the absence of the certified project activity."[37,38] The first step is the establishment of a credible baseline. A baseline is the scenario that predicts GHG emissions that would have occurred without the CDM. It is against this baseline of projected emissions that a project's net emission reductions are measured. In other words, the estimated baseline emissions *less* the measured project emissions equal the project's emission reductions (and ultimately the number of CERs issued). An offset's credibility hinges in large part on the strength and realistic grounding of this projected baseline scenario. Obviously, if the resulting emissions from the proposed project and the baseline emissions without the project are the same then there are no "additional" emission reductions. Similarly, if the proposed project results in an increase in emissions relative to the baseline scenario, then again there are no emission reductions and no credits would be issued.

Establishing a baseline scenario and determining additionality under the CDM includes four steps. The first step is to identify all possible alternatives to the proposed project. For example, suppose a manufacturer generates process steam by operating a boiler run with heavy fuel. Now, suppose that this producer proposes to change its steam-generating equipment to operate on wood residue (e.g., sawmill waste) instead of heavy fuel oil. Under the assumption that combusting this wood emits no net CO_2 emissions, by switching to this new fuel the producer will be lowering its overall GHG emissions.[39]

Alternative baseline scenarios in this example could include:

- The continuation of the status quo (keeping the heavy fuel oil boiler);
- The proposed project activity as described above;
- Adoption of other economically feasible technologies or approaches such as replacing the old boiler with one that operates on natural gas or removing the old boiler and importing the steam from a neighboring company.

When identifying likely baseline scenarios, all relevant current or planned policies and regulations must be taken into account. If there is a regulation in place that requires the changes described in the proposed project (e.g., all boilers must operate on wood residue), then the emission reductions would eventually occur by force of law. No additional intervention is then needed to enable the project's implementation and the proposed project would not be additional.[40]

The second step is to establish a complete list of realistic barriers that may prevent or inhibit any of the alternative baseline scenarios from occurring. Such barriers may include:

- **Investment barriers.** For example, project developers in rural Africa may not be able to access investment capital even for potentially profitable projects.
- **Technological barriers.** For example, a region may lack the infrastructure and/or skilled labor necessary to implement, operate and maintain a new technology that might be more commonplace in the developed world.
- **Other barriers specific to the region or country.** For example, some technologies may be unsuitable in tropical climate conditions, or local government policies or cultural norms may forbid or discourage their use.

If it can be documented that a scenario would be prevented by one or more of the above barriers, then it is eliminated from consideration. If barriers prevent all but one of the identified scenarios, then that scenario is selected as the baseline. If the proposed project activity itself is the only remaining baseline scenario candidate, then the proposal is deemed to be not additional.

In keeping with the boiler example above, there may not be a neighboring company producing steam or the natural gas pipeline infrastructure may not extend to the project site, rendering these two alternatives infeasible. If several feasible scenarios are left after the barrier analysis, then the CDM requires a subsequent investment analysis. It is also possible for a project to skip the barrier analysis and go directly to the investment analysis, if the project proponent believes that this test would be the most conclusive. A proponent thus has the option of doing either the barriers test or the investment analysis; of the two, the barriers analysis is the most common.

An investment analysis typically makes use of financial indicators that are appropriate to the project type and decision-making context.[41] The scenario with the best financial performance is then selected as the baseline scenario. Because of the potential for manipulation in an investment analysis, the CDM requires sensitivity tests to be conducted to observe how changes in values of key variables affect the results of the analysis.[42]

Again, using the previous boiler example, if there were no neighboring company producing steam, and the natural gas pipeline infrastructure did not extend to the project site, these two technological alternatives would be infeasible and only two options would remain: keeping the heavy fuel oil boiler or switching to wood residue. If the investment analysis clearly demonstrates that maintaining the status quo is the most financially attractive alternative, then this would be considered the baseline scenario.

The fourth and final step in determining additionality is the common practice analysis. This analysis is a credibility check on the previous steps and looks at the extent to which the proposed project type has already spread throughout the relevant industry and geographical area. Project proponents must provide data on the extent to which activities similar to the proposed project (not including other approved CDM projects) have been implemented previously or are currently underway. If the proposed project appears to be common practice, then the proponents must demonstrate why theirs is distinct[43] from these similar activities.

If the proposed CDM project will reduce emissions compared to the baseline scenario identified through these four steps, then the project is deemed additional. Each project must submit documentation based on the above process to an independent auditor, who must certify its accuracy before it is submitted to the Board for further consideration and project registration.

Additionality Concerns and Analysis

In spite of having a fairly rigorous multi-step process to determine additionality, concern has been expressed about the additionality of some CDM projects and it is widely recognized, even by the Board, that some non-additional projects were likely approved in the early period of the CDM.[44] Initially the program was focused on the promotion of market liquidity through the early issuance and trading of CERs, and it had neither the procedures nor the resources to thoroughly review all projects.[45] Over 80 percent of projects during this period (2005 to early 2007, Figure 7) were registered with little Board review. Compounding this lack of review, there was also less guidance available in the early years for project developers, auditors, or even the Board on how to apply the concept of additionality. In one study, Au Yong (2009) asserts that as of August 2008, 26 percent of registered CDM projects (primarily wind and hydro projects) were of questionable additionality because CER revenues improved the internal rate of return (IRR) for the project by less than 2 percent.[46] The project IRR, however, is only one aspect of a project's viability and other barriers may exist, which might imply that Au Yong's estimate could be high. Unfortunately, there is no perfect way to assess additionality in the CDM process and further study is needed.

As the program has matured over the last several years, a great deal of learning and program improvements have taken place. The knowledge and skills of all of the players in the CDM process (e.g., project developers, auditors, the various CDM panels and teams, as well as the UNFCCC secretariat) have increased greatly, leading to higher quality project proposals as well as more systematic and rigorous review of project proposals. For example, a more stringent early selection process is now taking place as auditors indicate they are more frequently refusing to audit projects unless their initial evaluation indicates that the project is likely to earn their certification and be registered by the Board.

The CDM has also put in place more detailed methods and requirements, added new layers of audit and review, and increased the human resources dedicated to the process. Specifically, both to increase the rigor of the process and to deal with the influx of new projects, the Board established a separate registration team that assesses each project and highlights potential issues for the Board's review. The UNFCCC secretariat also now provides more resources and staff support to the review process by summarizing both project documentation and the findings of the audit and review processes, which increase the efficiency of the Board (Table 1).[47]

Table 1. UN Resources Dedicated to Administering the CDM

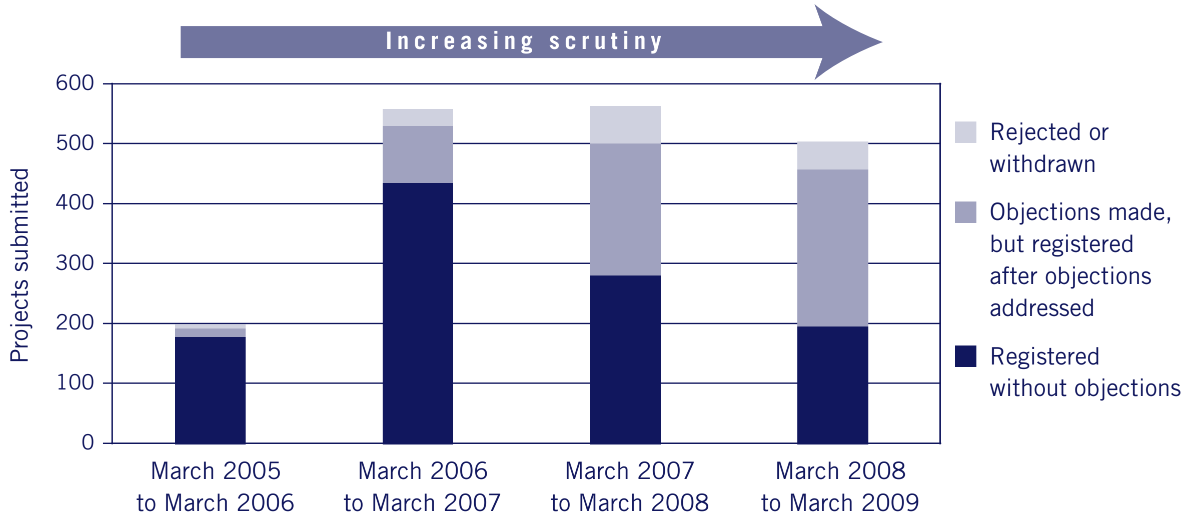
Resource item	2005	2006	2007	2008	2009	2010
Total annual budget (US$ millions)	–	11.2	15.3	22.0	28.1	34.5
Professional staff	7	24	47	62	93	122
Service staff	5	16	24	31	44	48

Source: UNFCCC (2010a), UNFCCC (2009a), and UNFCCC (2005a)

Note: Does not include outside experts, Executive Board, panel, team, or workgroup members. Also, 2010 data excludes 24 staff members shared with JI team and information technology group.

These improvements in the scrutiny of the CDM registration process began to have a significant effect in 2007. Prior to this time, the proportion of projects rejected or selected for more rigorous investigation by the Board was around 10 percent, while in 2009 it had increased to 61 percent (Figure 7).

Figure 7. Increased Scrutiny in CDM Project Registration Process



Source: UNFCCC (2009b)

Despite these improvements, the single largest reason for rejection of proposed CDM projects is the inability of project proponents to credibly demonstrate additionality using the process described above (Table 2). The second most common reason is the improper use of an approved baseline and monitoring methodology.

Table 2. Reasons for Project Reviews and Rejections

Reason	Project under Review	Project Rejection
Failure to demonstrate additionality	67%	71%
Improper use of the baseline & monitoring methodology	27%	25%
Other	6%	4%

Source: IGES (2010).

Note: Data are based on all CDM projects in the pipeline as of June 2010. The values should read, for example: since the beginning of the CDM, 71 percent of all rejected CDM projects were rejected due to the project developer's failure to adequately demonstrate additionality.

Because the CDM process is still evolving, the process for determining additionality under CDM is also still evolving and as such is still largely reliant on somewhat subjective judgments of project proponents, auditors, and the Board. As a consequence, project proponents continue to submit proposals with little certainty as to whether they will be approved.[48] The amount of time required for project approval also continues to be lengthy, due in part to more thorough review measures. Greater transparency and standardization of the additionality process—as well as more training and professionalization of the Board, its support staff, project proponents and auditors—are still needed.[49]

Additionality Lessons Learned

While the CDM's additionality process has evolved and improved with growth and experience, it has become increasingly clear that new approaches are needed to reduce the subjectivity of the process for applicants and reviewers, increase efficiency, and provide greater investor certainty.[50] These more standardized approaches include options such as the development of performance standards (e.g., additionality and baseline benchmarks) for certain project types and lists of specific project types that are automatically deemed additional or non-additional (i.e., positive and negative lists).[51]

The development of performance standards or pre-approved project type lists would require quantitative metrics for each project type and an understanding of the presiding economic and technological conditions. These standardized approaches should increase the efficiency of the process and, if carefully designed, they would also improve the accuracy of additionality determinations. However, developing and maintaining these metrics for the wide array of project types and countries would require significant resources, time, and expertise. That said, such an investment would likely make sense for the most common project types, as well as for those in which additionality is more obvious, such as, where credit revenue is expected to be large relative to other project revenue sources.[52] In fact, the CDM has begun approving a few standardized methodologies for determining additionality and baselines, such as the methodology for the manufacture of energy-efficient refrigerators which provides efficiency benchmarks for calculating the energy savings of refrigeration, equipment, and pre-approved additionality for certain types of small-scale renewable and energy efficiency projects.[53]

The application of a discount factor on the number of credits generated by a project has also been proposed as a way to address additionality.[54] While a discount factor could attempt to take into account the uncertainties in the process of determining additionality for each project type, developing these factors would be challenging. Furthermore, unless these factors were specific to each individual project, they would equally penalize all projects of a given type regardless of their quality. A discount rate also does nothing to prevent the approval of non-additional projects.

2. Measurement

Accurate measurement is fundamental to ensuring offset quality, and CDM methodologies generally provide rigorous requirements and specifications for how emission reductions are calculated. The CDM requires the measurement of actual project emissions and, in many cases, the use of actual measurement data for project baselines (e.g., historical production data). In the several years since the start of the CDM, over 140 standardized baseline and monitoring methodologies and tools have been approved that address the specific technical issues for a wide diversity of project types (Appendix)[55] as well as providing standardized and detailed rules for monitoring emissions, calculating emission reductions, and estimating emissions leakage (leakage is addressed in a later section).[56]

Baseline and monitoring methodologies are initially drafted and submitted by project developers. These proposed methodologies are first made available for public comment, and then must be certified by an independent auditor as technically valid and aligned with CDM requirements before they are reviewed by a panel of technical experts, known as the CDM methodology panel. Experts are drawn from a pool of hundreds, who attest to having no conflict of interest with the proposed project or parties participating in the project.

Numerous experts from the United States participate on these panels and serve as peer reviewers.[57] Based on the recommendations of its methodology panel, the Board reviews each methodology before approving, rejecting, or specifying revisions. If approved, a methodology becomes a standard for use by other CDM projects in the same category. Approved methodologies are frequently revised by the CDM methodology panel based on new science and experience from their application in actual projects.

CDM methodologies are public and follow the principle of conservativeness, which means that assumptions, equations, and procedures are considered intentionally biased to ensure that emission reductions are not overestimated.[58] Because the CDM methodology library predates most other regional and international programs, its methodologies have laid the technical foundation for other mandatory and voluntary GHG emission reduction programs around the world, including those in the United States.[59]

Measurement Concerns and Analysis

One concern often expressed about the CDM process is the project-by-project nature of each methodology. In the early days of the CDM, there were few standardized methodologies available and project developers had to propose new methodologies for quantifying emission reductions and also incur the expense for their development and review. Over time and as experience has been gained in applying methodologies to actual projects, many of these methodologies have been repeatedly re-examined, revised and improved. Similar methodologies have also been consolidated into the largest library of standardized GHG offset project protocols in the world. The applicable methodology for hydro and wind projects, for example, has been revised multiple times and used more than 1300 times.

While revision is essential as data and knowledge are improved, some project developers and auditors have complained about stranded investments when methodologies were revised after a project had been initiated.[60] To address this problem, the rules of the CDM have been altered to delay the effective date of methodological revisions to give project developers a reasonable period of time to plan their investments.

Measurement Lessons Learned

Overall, large investments of expertise and time have gone into developing CDM measurement requirements resulting in technically rigorous methodologies.[61] A recent comparative study of methodologies from various offset programs for the Western Climate Initiative (WCI) found that CDM methodologies were consistently the highest quality for each type of project considered.[62] The existence of methodologies can be a significant benefit for new offset programs because methodologies are essentially public goods. As public goods they also suffer from the classic problem that no one wants to bear the costs of developing them (since creation of the first methodology for a project type basically gives away free intellectual capital to other project developers). And, while these methodologies are "public goods", the transparency of the approval process for some methodologies has been lacking, such that technical justifications for these decisions are not always clear to project proponents.[63]

With an increasingly large and detailed library of methodologies, it is a challenge for the CDM to continuously review and improve existing methodologies while also considering new methodology submissions. Plus, with increased standardization of additionality and baseline approaches, there will be even greater demands on experts for the measurement and collection of metrics upon which to build standardized approaches. The Board will increasingly require a system of consolidated rules, decisions and guidance documents as well as professionalized staff and auditors with greater expertise to maintain and expand measurement rigor and specificity.[64]

3. Auditing

The concept of using audits for quality assurance and to ensure credibility is not new. It derives from the tradition of financial auditing and technical inspections common in many industries. The CDM requires two specific types of auditing—one for validation and the other for verification. As noted previously, validation is generally undertaken prior to implementation of the proposed project to ensure that it meets all of the CDM's eligibility requirements whereas verification is the periodic audit of a project's estimated GHG emission reductions.

The validation and verification processes enlist resources and expertise from the private sector to help assess the eligibility and performance of emission reduction projects. The audits are performed by independent third parties called Designated Operational Entities (DOEs or auditors). The Board, with the support of an accreditation panel and assessment teams, accredits auditing firms who have demonstrated that they are technically competent, free of conflicts of interest, and have sufficient quality control and management systems in place. A CDM assessment team (CDM-AT) investigates each auditing firm when it applies and again when it renews its application and then it reports its findings to the CDM Accreditation Panel (CDM-AP). The CDM-AP makes technical recommendations to the Board on each application for accreditation.

To demonstrate that they have sufficient technical competency, CDM audit firms are accredited separately for each of the CDM's 15 sectoral scopes (e.g., an auditor needs separate accreditation for agricultural projects and energy industry projects). Specifically, a CDM accreditation assessment team reviews an auditor's application materials, makes an on-site inspection of their management systems, and evaluates their performance during an actual project audit.[65]

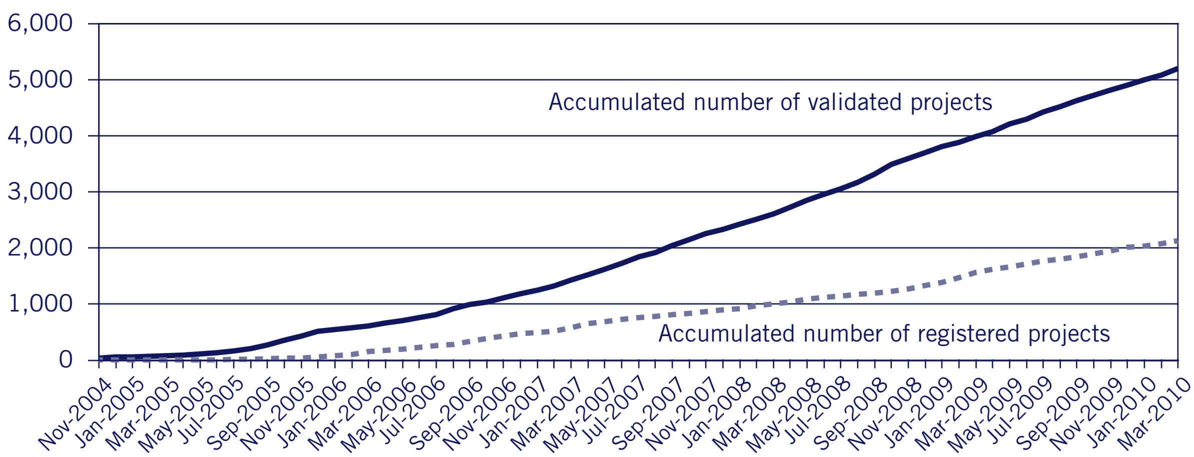
Once a CDM project has been implemented and emission reductions have occurred, the project must undergo verification before credits can be issued. Except for small projects,[66] verification must be carried out by a different auditor from the one that conducted the validation to ensure the audit is not biased by past opinions or errors. After they have certified the proposal or credit issuance request, the auditor submits the project documentation to the Board on behalf of the project developers, who have the responsibility for both selecting auditors as well as paying costs of validation and verification.

Auditing Concerns and Analysis

Auditing under the CDM is technically well-developed, but serious structural problems remain within the overall quality assurance processes. Auditors bear a significant portion of the burden for reviewing projects, and because they are paid by the project developers, there is the potential for conflicts of interest that could result in less than rigorous project auditing.

Further, while project auditing is structured to facilitate competition between firms, current demand for services from the 26 accredited auditors significantly exceeds the capacity of these firms and delay is the result.[67] Figure 8 illustrates the gap between projects submitted to the Board and those that have completed the validation audit. The number of projects seeking validation has increased substantially, while the number of projects that have been registered has not followed the same steep trend. Notably, the average number of projects that have requested validation has increased from 5 per month in 2004 to around 100 per month in 2009. This type of backlog not only delays the project approval process, it also can lead to less than high quality auditing and is a disincentive for new project investment. In the scramble to meet client demands, the competency of some auditors and the rigor of their review may be compromised as audit firms attempt to finish projects quickly in order to handle the growing backlog. One of the most serious issues for maintaining the quality of CDM projects is the impact of this rapid growth on the adequate supply of audit firms with the necessary technical competency and experience.

Figure 8. Projects Submitted for Validation and Projects Registered Over Time



Source: UNEP Risoe (2010).

Note: Data as of March 2010.

The job of ensuring the competency of audit firms primarily rests with the CDM accreditation process. In a demonstration of its growing concern with the quality of audit work, beginning in November 2008 the Board temporarily suspended the accreditation of four of its auditing firms for problems with their audit practices and other non-conformities, including a lack of human resources and competency. After corrective actions were taken, the accreditation of two of these audit firms was reinstated in December 2009.[68]

The huge demand for audit firms may have one redeeming quality—it might help with the inherent conflict of interest that can arise because auditors are "beholden" to the firms that hire them. In a situation where there is a shortage of audit firms and there is no lack of clients, client loyalty (and the inherent conflict of interest) may be somewhat reduced since firms can always find another client if their audit results are not positive. While this may be the case now, the auditing element of the CDM is set up to incentivize competition between firms. Consequently, the supply-demand imbalance for auditors should eventually resolve itself and with this resolution, the pressures to attract project clients and the incentives that arise from being "beholden" to those that pay the bills will be more significant.

Auditing Lessons Learned

Since the launch of the CDM, auditors, the Board, and project developers have gained tremendous experience on how to perform, prepare, and review audits. The Board, in an effort to improve the efficiency of the review process, has also added staff and internal review teams which have helped to decrease the average time required to complete the project validation and registration stage from just over 600 days down to 285 days (2004-2008).[69,70] As of March 2010, more than 660 projects have undergone verification and more than 385 million CERs have been issued.

Table 3 shows the number of projects that have been issued CERs, as well as the success rate of different project types. The success rate is a measure of number of CERs actually issued relative to the number of CERs predicted in each project's original design documents. Projects with a success rate below 100 percent have delivered fewer CERs than expected, while projects above 100 percent have exceeded expectations. Table 3 demonstrates the importance of auditing and reviewing projects before issuing CERs because actual performance often significantly differs from expectations.

Table 3. Delivery on CER Expectations

Types of CDM Project	Projects	Issued Credits ('000s)	Actual Versus Predicted
Biomass energy	129	16,359	86%
Cement	8	1,321	69%
CO_2 capture	1	10	31%
Coal bed/mine methane	12	3,379	47%
Energy efficiency industry	26	1,384	83%
Energy efficiency own generation	62	20,858	80%
Energy efficiency service	1	6	63%
Energy efficiency supply side	7	425	78%
Fossil fuel switch	31	7,842	52%
Fugitive	2	4,600	114%
Geothermal	5	684	38%
HFCs	18	237,303	105%
Hydro	203	24,221	89%
Landfill gas	51	10,644	36%
Methane avoidance	66	6,897	47%
N_2O	21	114,195	123%
Solar	1	1	18%
Transport	2	201	42%
Wind	171	24,246	84%
Grand Total	**817**	**474,577**	**95.6%**

Source: UNEP Risoe (2010) CDM Pipeline Overview, Analysis, Table 2, accessed 17 December 2010.

Note: Data represents registered CDM projects where issuance was requested.

When the CDM process was being negotiated, it was expected that the program could largely, if not completely, rely on independent auditors to assure the quality of offsets. It is now clear that the CDM, not unlike other industries that have relied on private sector auditors and rating agencies, requires a greater degree of quality assurance oversight. In response, the Board has enlarged its support staff, increased oversight of auditing practices, and more thoroughly reviewed projects even after they have been audited. In addition, the Board, in cooperation with auditing firms, released a detailed Validation and Verification Manual (VVM) in November 2008. While it is expected that this manual will improve the quality and consistency of CDM project auditing, it provides limited guidance on key issues such as additionality. To further ensure the competency of audit firms, more standardized training, testing, and/or professional certification is needed for individuals employed by audit firms.[71] Similarly, those who oversee auditors in the CDM's accreditation assessment process would also benefit from training, testing and professional development.

Finally, to better align the incentives of auditors with the objectives of the CDM and avoid potential conflicts of interest, auditors could be assigned to projects by the Board instead of being selected by project developers and paid using an established fee schedule.

4. Ownership

Offsets can be both a legal entitlement to emit GHG emissions and a tradable commodity with a market value. As such, they can convey a quasi-property right,[72] making it of paramount importance that an offset's creation, title of ownership, and conditions for exchange are clearly defined, documented, and tracked in an unambiguous and transparent manner. The creation of offset credits used within a domestic or international emissions trading program needs to be sanctioned by all relevant governments and supported by explicit legal safeguards for settling ownership disputes and preventing double counting. The CDM has mechanisms in place to ensure these ownership characteristics.

Prior to being submitted for registration, each project must obtain a written Letter of Approval from the host country government as well as any other countries actively participating in the project. Every country participating in the CDM must establish its Designated National Authority (DNA) to administer this approval process. In approving a project, governments effectively recognize the identified project participants as having ownership rights over any CERs issued.[73] The allocation and transfer of CERs among project participants and other private parties is separately defined through private contracts between those parties.

Offset credits are individually serialized and accounted for in a CDM registry, in which transfer of ownership is clearly documented to prevent double counting. The CDM registry is linked with national government registries under the Kyoto Protocol and data transaction checking procedures, equivalent to those used by the banking and financial industry, are utilized. The CDM registry assigns a unique account number for each market participant and each CER can only be held in one account at any given time.[74] The registry is designed to enable the transfer of CERs between national holding accounts. For a transfer to take place, project participants must have authorization from the developed country wishing to receive CERs into their national registry, and from the host developing country that initially approved the project.[75] The legal and credit registry processes under the CDM are generally considered sufficient to ensure that CERs are unambiguously owned and transacted without double counting, while also respecting national sovereignty. The issue last year where Hungary resold some CERs provides an example of how the registries assure no double counting, since the CERs were submitted for compliance, their serial numbers were already "accounted" for in the EU registries. Thus, they could not be used again in the EU-ETS, as the registries would have identified them as invalid.

5. Leakage

Under the CDM, leakage is defined as the net measurable change in GHG emissions that occur outside a project's boundary,[76] which can be directly attributable to the project.[77] For example, an offset project that prevents deforestation in one area could simply result in trees harvested elsewhere. If there is no decrease in the overall level of deforestation, the emissions from deforestation simply "leaked" to another location that would not have otherwise been deforested. Leakage must be considered for all project types, but it is especially challenging for forestry projects.[78]

Offset program methodologies must address leakage to prevent the emission reductions claimed by some projects from simply being an artifact of incomplete accounting. Specific rules and methods for defining project boundaries as well as monitoring and calculating leakage are specified in each of the CDM project methodologies. Project developers must follow the prescribed procedures in each methodology for quantifying leakage and deducting it from the total credited reductions. Transportation projects, as well as forestry and other land-use project types, continue to present CDM with some of the most vexing challenges for applying approaches to address leakage.

6. Permanence

For some types of offset projects, emission reductions can be reversed. For example, CO_2 sequestered by a forestry project could be released back into the atmosphere, voluntarily or accidently, if the forest is prematurely harvested or destroyed due to a forest fire, disease, or insect infestation. Provisions are thus needed to monitor and account for any actual reversals. For now, because of the types of projects currently allowed under the CDM, this threat is limited to afforestation and reforestation projects that biologically sequester CO_2.

The approach used by CDM to address permanence has been to define a special type of expiring or "temporary" credit (tCER)[79] that must be replaced by a specific time in the future. Temporary credits fully account for the potential of reversals with biological carbon sequestration projects. However, both because they need to be replaced and because the EU has prohibited their use under its cap-and-trade program, they trade at lower prices than permanent CERs and have inhibited investment activity in forestry projects.

Since deforestation accounts for over 15 percent of global GHG emissions, there is a renewed interest in forestry offsets, which has led to consideration of other options to deal with potential reversals. These options include, but are not limited to, reserve pools, buffer accounts, project insurance, and bonding. Reserve pools require that a portion of the credits generated by all projects at risk of reversal be put into a collective insurance pool. Buffer accounts require that the risk of reversal for each project be quantified and, based on the project's risk rating, a portion of the credits generated are set aside as a buffer in the event of a reversal. Project insurance functions similarly to other types of insurance. If a reversal occurs, then the insurance provider would be required to replace the credits on behalf of the insurance policy holder. Project developers could also be required to purchase and hold bonds that would be sufficient in value to replace any credits lost to a reversal. Overall, the approach currently employed by CDM—the use of temporary credits—while more than fully addressing the issue of permanence, has not been widely accepted by policy makers or project investors as it appears to have inhibited investment in forestry projects. The EU specifically does not allow temporary credits in their program, and afforestation and reforestation projects account for only 0.54 percent of all registered projects.[80]

V. Implications for Developing Countries

Although the primary objective of the CDM is to stimulate emission reductions in developing countries while giving developed countries some economic flexibility to meet their targets, the CDM also has another objective—to promote sustainable development and the transfer of cleaner technologies to developing countries. This section discusses to what extent the CDM appears to have achieved these two objectives as well as the broader geopolitical implications of the CDM within international climate change policy.

CDM's Role in Technology Transfer

While historically developed countries have been the main contributors of GHG emissions in the atmosphere, more recently emissions from developing countries, primarily the large emerging economies, has been on the rise. An International Energy Agency study concluded that 56 percent of the growth in emissions between now and 2030 will be from China and India. By incentivizing the private sector to seek out low-cost emission reduction opportunities in developing countries, international offset programs bring human resources, information, and capital to these countries while also transferring mitigation technologies.

The UNFCCC and Kyoto Protocol both require participating countries to promote and cooperate in the development, application and diffusion (transfer) of technologies. Although the CDM does not have an explicit technology transfer mandate, it does appear to contribute to the transfer of technology to developing countries.

In each CDM PDD, project developers include a description of whether or not the technologies proposed are environmentally safe and if there will be a transfer in technological "know-how" to the developing country host. It may be inferred from the information in PDDs that project developers almost universally interpret technology transfer to mean the acquisition of equipment and/or knowledge not previously available in the host country.

Seres and Haites (2008) analyzed the claims made in 3,296 PDDs and found that technology transfer was involved in 36 percent of the reviewed projects accounting for 59 percent of the annual emission reductions. They also concluded that technology transfer varied widely across project types, but occurred more often in larger projects. It was also more common for projects that have foreign participants, possibly because those projects tend to be larger. Five countries were the sources of over 70 percent of the transfer of equipment or knowledge under the CDM: Japan, Germany, the United States, France, and Great Britain (16 percent of the high tech equipment and 11 percent of the hired expertise used in CDM projects came from the United States). Greater participation by the United States in the CDM would likely increase the technology transfer of U.S. technologies to developing countries, thereby leading to greater exports and business opportunities for U.S. businesses.

This study also found that as more projects of a given type are implemented in a country, the rate of technology transfer declines, but the process facilitates the wider adoption of transferred technologies in the host country because a local knowledge base is created.[81]

CDM's Impact on Sustainable Development

In addition to reducing GHG emissions and promoting technology transfer, CDM projects can help to bring economic development and broader environmental benefits to poor regions of the world. For example, a renewable energy project in rural Africa can create employment opportunities, improve lighting and refrigeration for medicines, provide water purification, and prevent deforestation from the harvesting of fuel wood and the operation of polluting diesel generators. While there may be such co-benefits for many projects, by most accounts, explicit systems have not been established to ensure that the CDM's sustainable development goals are achieved.[82]

The UN defines sustainable development as a strategy that "meets the needs of the present without compromising the ability of future generations to meet their own needs."[83] However, the Kyoto Protocol does not define sustainable development explicitly, nor does it provide guidance on how it should be achieved or measured within the CDM. As such, the promotion of sustainable development under the CDM is largely delegated to host developing country governments, acting through their DNAs.[84] To support host country governments in their decision-making process, the CDM requires that project proposals include an explanation of how they contribute to sustainable development. Yet there are few, if any, cases of projects being rejected by host country DNAs, which could be seen as an indication that national sustainable development criteria are insufficiently ambitious or are not being rigorously applied by DNAs.[85]

Most developing countries do not appear to favor projects with high sustainable development benefits over other projects that have few or no sustainable development benefits.[86] Developing countries have few incentives to apply stringent criteria for sustainable development since they are effectively competing for CDM projects with other developing countries. More stringent standards could raise the cost of projects and deter potential investors. The CDM review process does include procedures to ensure projects do not cause adverse economic, social, or environmental harm. Yet, few procedures exist to ensure that projects produce social and environmental sustainable development benefits.[87] Until more specific sustainable development criteria—at the global or national level—are introduced, it is difficult to objectively assess to what degree the CDM contributes to this goal.

Early in the CDM program, a significant fraction of the emission reductions have come from a few large projects that reduced GHG emissions at low cost, for example industrial HFC and N_2O abatement projects, but which delivered limited sustainable development benefits other than reduced GHGs.[88] Although these projects produced high quality offsets at a low cost, they did little to introduce innovative technologies, reduce other forms of pollution, or otherwise benefit local communities. Similarly, the vast majority of CDM project investment has gone to a few relatively larger economies in the developing world, bypassing the poorest countries that are arguably in greater need of assistance (Figure 4 on page 11). The international offset market will naturally gravitate towards emission reduction opportunities with the lowest cost (including transaction costs such as those related to obtaining approval from host country DNAs) and no quotas currently exist for how many reductions can come from particular countries or geographic regions. The offset market has therefore targeted countries with the greatest emission-reduction potential and favorable investment climates (e.g., China, India, Brazil, and Mexico). The case of the HFC and N_2O projects is simply an example of the market capturing the "lowest hanging fruit" first.

Arguably, the limited success of the CDM in achieving its sustainable development goals can be partially attributed to the insistence of national governments on preserving sovereignty over their own domestic development decisions. The autonomy of each country's Designated National Authority (DNA) to approve or reject projects is an example of this. Consequently, the lack of emphasis on sustainable development should not be attributed solely to the CDM program nor should it be a rationale for rejecting the CDM as a source of international offsets. Furthermore, as most of the low hanging fruit has already been picked, more investment has recently gone into energy efficiency and renewable energy projects (i.e., projects with greater potential for promoting low-emission economic development) instead of the large industrial GHG capture and destruction projects. Numerous changes to the CDM are also underway that could lead to more projects that contribute to sustainable development, including the adoption of rules to allow a "program of activities" or "programmatic CDM" (e.g., multiple small-scale energy efficiency improvements).[89]

CDM's Role in Capacity Building

Similar to promoting sustainable development, the CDM has a role to increase the host country's capacity and experience in carbon mitigation projects. Through engagement with offset projects and the CDM, the private and public sectors in developing countries gain experience in areas such as project finance, environmental assessment, emissions monitoring, and emissions trading. As these countries develop the experience and institutions to engage in carbon trading, they will likely become more capable of successfully initiating and meeting GHG mitigation goals.[90]

A great deal of private capital and a growing community of public and private sector personnel are actively engaged in the CDM market. Technical experts from around the world, including in developing countries, are now actively engaged with the technical, institutional, and financial elements necessary to build a robust global emissions trading market. To ensure that CERs are globally comparable in their quality, this capacity building needs to be further formalized and professionalized (e.g., through educational and personnel certification programs).

Perverse Incentives

Concern has been raised from a number of sources that monetizing emission reductions from some types of sources can create perverse incentives and actually cause emissions to increase. This concern has been most prominently associated with CERs generated from reducing emissions from the industrial gas HFC-23. Trifluoromethane, or HFC-23, is a waste gas resulting from the production of the refrigerant gas HCFC-22. HFC-23 has a very large global warming potential (GWP) value meaning that every ton of HFC-23 destroyed is equivalent to destroying 11,700 tons of CO_2.

Even though HFC-23 projects account for a small number of CDM projects (Figure 5 on page 12), in the early years of CDM they were responsible for generating a disproportionately large number of CERs. These projects were popular due to their ability to achieve large GHG emission reductions for a relatively small investment using well-established technologies. At the same time, these projects have been heavily criticized for delivering large windfall profits to their project developers.[91]

Specifically, it is estimated that CER revenues from HFC abatement projects in China will total $6.2 billion, while the estimated costs of abatement are likely less than $150 million.[92] In the United States and other developed countries, many factories (but not all) producing these waste gases have voluntarily eliminated their emissions. In the developing world, by contrast, these gases were simply released until the CDM gave these projects a financial incentive to do otherwise.

A market-based mechanism is expected to identify and capture the lowest cost emission reductions first, and with the HFC-23 projects, the CDM and project developers have done exactly that. These projects generated low cost emission reduction opportunities that were quickly exploited by the offset market. Further, these projects are highly additional, since there would have been no economic reason to invest in emissions control equipment at these facilities were it not for the CDM.

Nevertheless, in the future, few new HFC projects are likely to be eligible under the CDM. Other policies may actually be more appropriate for reduction projects that involve little uncertainty about mitigation technology and are fairly low cost. If governments and industry can agree to reduce emissions from these sources directly through targeted funding or regulatory approaches, this would likely be more cost effective than through an offset mechanism. International offset programs may be best suited for capturing the numerous emission reduction opportunities around the world that are smaller and are more challenging to identify and implement. In these cases, deploying the creativity and entrepreneurship of an offset market may be preferable.

Other policy mechanisms, like an international fund or a regime similar to the Montreal Protocol (if they can be established) could prove to be more cost-effective for these types of projects than the current offset approach, given that the amount paid for the HFC CERs far exceeded the cost to achieve those reductions.[93]

In addition to the cost effectiveness of these types of offsets, another concern about HFC-23 destruction projects is that there is potentially a perverse incentive to produce more HCFC-22 (of which HFC-23 emissions are a by-product). To address this possibility, the Board has decided that only pre-existing HCFC-22 production facilities are eligible under CDM—new facilities cannot receive CERs. Furthermore, credits issued for existing facilities are based on historical HCFC-22 production levels, meaning that project owners cannot excessively boost CDM revenues by increasing production.[94] Further measures to address this concern are also under consideration by the Board. A fundamental lesson from the HFC controversy is that not all issues can be anticipated in advance of the policy and as such, the policy must be flexible enough to accommodate a learning-by-doing approach.

Another concern regarding perverse incentives was that the CDM may discourage developing countries from taking unilateral steps to reduce their GHG emissions.[95] As projects that would happen anyway (e.g., those required by law) are generally not eligible to receive credit under the CDM, the concern is that developing countries will avoid implementing policies to reduce GHG emissions themselves in order to continue receiving revenues from the CDM. To address this concern, the rules of the CDM now explicitly accommodate developing countries wishing to take progressive measures to curb their GHG emissions. Specifically, in 2005, the Board issued a decision clarifying that any laws or policies put into place after November 2001 do not need to be taken into account in determining the baseline of CDM projects.[96] Therefore, developing countries are free and encouraged to pass new laws to reduce GHG emissions without affecting the ability of projects that comply with those laws to be deemed additional and generate CERs.

Similarly, concern is often expressed that the sheer existence of a mechanism that pays for reductions would reduce the incentive for a country to adopt rules and regulations that require those reductions (such that they must be financed with domestic resources). Specifically, the concern is that the existence of the CDM could deter developing countries from agreeing to legally binding mitigation commitments in a future global agreement. In the near-term, however, this argument does not account for political and practical realities. Many developing countries lack the economic, administrative, and technical capacity to take on strong commitments to reduce emissions. Programs like the CDM can play an important role in helping developing countries grow their capacity by giving them access to, and experience with, clean technologies and market-based mechanisms. For example, India is currently in the final stages of implementing an energy efficiency and renewable energy certificate system, and it has been reported that China is exploring the option of a domestic cap-and-trade program.[97,98] Further, current international negotiations are exploring the possibilities of other crediting mechanisms like sectoral and policy-based approaches. Recent U.S. legislative proposals also required a gradual transition from the current CDM to a more sectoral type of crediting approach for some countries. Such mechanisms may create a pathway for developing countries to transition to the use of cap-and-trade systems in the future.

The CDM has played an important role in the international climate negotiations and discussions surrounding the CDM's process and use will likely continue in the future. As the CDM builds capacity in both the public and the private sectors of developing countries, it also may serve as a potential bargaining tool for developed countries, such as the United States, who could be large buyers of CERs. Developing countries may potentially be more willing to accept some form of longer-term commitment to limit their emissions in return for maintaining a funding source for GHG mitigation technology in the short-term. To this end, the CDM will likely play a role in the negotiations on a future international treaty on climate change.

VI. Summary and Conclusions

Market-based policies have shown to be cost-effective tools in mitigating emissions. Under a wide range of potential policy scenarios, international offsets represent some of the most economically efficient options for reducing global GHG emissions.

The CDM is the primary international offset program in existence today and, while not perfect, it has helped to establish a global price on GHG emission reductions. Further, it has managed to establish—in just eight years—a fairly credible, internationally-recognized, carbon offset market that is worth $2.7 billion with participation from a large number of developing countries and private investors. It has also created processes and methodologies that other programs, like the Western Climate Initiative, are already emulating.

A "learning by doing" approach is an apt characterization of the CDM to date. While this strategy has enabled critics to accentuate the issues that have arisen, the alternative—debating and developing every methodology and procedure before launching the program, would have likely delayed the launch of the program for years and prevented it from achieving its objectives during the first Kyoto commitment period (i.e., 2008 through 2012). In addition, given the unprecedented nature of the CDM, even if it had been meticulously designed, policy makers likely would have found it impossible to accurately predict every challenge and some "learning by doing" would nevertheless have been required. A balanced assessment of the CDM should acknowledge two major conclusions—first, its early focus on expediency resulted in the creation of a global market in GHG emission offsets in a surprisingly short period of time and second, new programs are rarely perfect and in anticipation of this, the CDM was set up with the flexibility to adapt and alter its policy and procedures with experience—and it has and continues to do so.

The downside to the "learning-by-doing" approach is that naturally a variety of problems have surfaced. Initially, for example, there was limited technical guidance. With little technical guidance and little experience, project developers, auditors and even UNFCCC staff struggled with issues like additionality, leakage, measurement, and even how to audit. Consequently, it is very likely that some non-additional projects were initially registered and some early versions of methodologies were approved without full testing. Guidance documents and Board decisions are now more fully developed and widely available. The Board has also added staff and review teams to better evaluate and ensure the quality of projects before registration. Over the last two years, third party auditors have also come under increased scrutiny and the Board has sanctioned several companies. Conflicts of interest are inherent in the audit structure and while increased risk of penalty should help, having the Board assign auditors might be another option. In general, the trend towards more rigorous project review, increased standardization for additionality and baselines and more auditor oversight is very encouraging.

Industrial HFC projects have provided yet another source of learning given the perverse incentives which have resulted. Certainly the new rules implemented by the Board about what qualifies and the tax put into place by China (where these projects were occurring) have made these types of projects less common. However, because HFC emissions are so cheaply eliminated, a policy tool other than offsets may have been warranted. An international fund (if it could be implemented), for example, could be used to support HFC projects and would likely be more cost-effective than using an offsets mechanism. In an ideal world, an international offset program should be reserved for addressing project types and regions where the use of offsets is more cost-effective than other policy tools.

Yet, even with these issues, the CDM should be judged not on its past, but rather on its current operation and a realistic assessment of its potential, taking into account ongoing efforts at improvement and reform. The CDM continues to improve upon its processes as experience is gained with thousands of on-the-ground projects around the world. The CDM's Executive Board has attempted to acknowledge the critiques of the CDM where they have been valid and much discussion is ongoing about potential changes and options for more standardization, expansion into countries not currently utilizing the mechanism and most importantly—increasing its efficiency and scale. The CDM has also, in many ways, laid a foundation for technology transfer and capacity building for lower GHG-intensive development using an approach that actively engages private sector investment capital.

It is essential to recognize that after years of investment, the institutional apparatus of the CDM is fully operational and widely supported by industry and the international community. Currently no alternative institutional structure exists with a similar potential (Table 4). The creation of a new international offset system would most certainly require years of learning and adjustment. If high quality international offsets are to be integrated within a U.S. emission reduction program, and if that program is to be linked to systems in other countries, then it will be politically and administratively challenging, as well as potentially costly, for the United States to ignore the CDM.

Table 4. Summary of Institutional Accomplishments of the CDM

1. The CDM contains a library of over 140 standardized methodologies, and covers a diversity of project types. A great deal of time and resources have been expended developing, reviewing, approving, and testing methodologies. Having made this large upfront investment, the CDM is now able to operate with lower costs for all participants.
2. Standardized tools have been developed for a variety of functions that are common across projects such as determining additionality and baselines, and estimating emissions related to grid-connected electricity projects.
3. Standardized manuals, rules, and templates for auditing (i.e., validation and verification) have been developed and the CDM procedures for overseeing auditors are increasing in rigor.
4. The CDM has significantly added to the number and expertise of its support staff and panels from what was initially only a small Board. Collectively, the staff of the CDM now has several years of experience and increasingly well-elaborated rules and precedents.
5. National governments, including developing country host governments, have invested in institutional bodies (i.e., DNAs) and personnel for reviewing and approving projects.
6. Project developers, auditors, and DNAs have now established their own associations to share knowledge and promote best practices.
7. A global registry system and international transaction log for tracking information about projects and monitoring the trading of offset credits has been established and linked with national GHG emission trading registries.

Endnotes

1 The Kyoto Protocol applies to five other “greenhouse” gas categories besides CO_2, each with a different global warming potential (GWP), which is used to convert emissions to a common unit, referred to as a carbon dioxide “equivalent.” For example, methane (CH_4) has a global warming potential 21 times that of CO_2 on a 100-year time horizon.

2 World Bank Institute (2010)

3 See McKinsey (2009) and IPCC (2007) for estimates of global cost-effective GHG emission reduction potentials.

4 In UNFCCC negotiations, developed countries are referred to as “Annex I” while developing countries are referred to as “Non-Annex I.”

5 Hahn and Hester (1989)

6 Additionality for Clean Air Act offsets was addressed by issuing credits to existing sources for reductions below either allowable emissions or actual emissions (most of which were already regulated). This approach is not feasible for the CDM since few sources of GHG emissions in developing countries are regulated.

7 Ellerman et al. (2000)

8 Joint Implementation (JI) is similar to the CDM in that it is project based; however, while CDM projects can only be hosted in developing countries, JI projects can only be hosted in developed (Annex I) countries. Additional information can be found at http://unfccc.int/kyoto_protocol/mechanisms/emissions_trading/items/2731.php.

9 Weyant (2000)

10 World Bank Institute (2010). This includes only primary (CER generation) CDM transactions. All monetary data are expressed in U.S. dollars.

11 The Board contains one member from each of the five United Nation’s regional groups, two members from the Parties included in Annex I, two Non-Annex I members and one representative of the small island developing States. Each Board member has a single alternate member that participates in all deliberations and substitutes in cases of his or her absence.

12 The Conference of the Parties (COP) of the UNFCCC serves as the meeting of the Parties to the Kyoto Protocol. This is referred to as the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP). The CMP meets annually during the same period as the COP.

13 Under the formal terminology of the CDM, “review” refers to a process of giving special attention to a proposed project that appears potentially problematic. In this paper, the term is used to colloquially mean the general process of examining a project proposal. A formal “review” of a CDM project proposal is initiated if at least three Board members or one of the DNAs involved requests it.

14 A project developer may also be referred to as the “project proponent” or “project participant.”

15 See http://cdm.unfccc.int/auditor/list/index.html for complete list of DOEs.

16 Project proponents are to actively reach out to stakeholders to solicit their comments.

17 Project developers have discretion regarding the amount of time (it may be one month, one year, or more).

18 “Small scale” projects are allowed to use the same auditor for both validation and verification.

19 "Pipeline" is commonly thought of as the complete portfolio of projects at any stage of development. Once a PDD is submitted to an auditor for validation, the project is commonly considered to be in the CDM pipeline.

20 These numbers are estimated by project developers and for the most part represent value prior to the implementation. On average, projects have delivered 96 percent of predicted CERs. See UNFCCC (2010b) and UNEP Risoe (2010).

21 World Bank Institute (2010)

22 The initial generation of CERs by project developers is referred in financial terms as primary CERs, while secondary CERs refers to the marketplace where CERs are traded among participants.

23 Unless otherwise noted, prices are given in U.S. dollars and reflect the price of secondary CERs. While there is no official definition of primary and secondary CERS, common understanding is that secondary CERs tend to be CDM credits that have been resold and bear minimal delivery risk. In contrast, primary CERs are those issued (now and future) to project developers based on the underlying project. Because a project may have many years worth of credits, forward contracts are often used to monetize the value of these credits and consequently there is greater "delivery and performance" risk for this forward credit stream. CER prices tend to reflect this risk with primary CERs selling at prices that are typically lower than secondary.

24 EUAs and CERs trade on the market for a variety of prices. Prices reflect December delivery of 2012 vintage EUAs and primary CERs as reported by Point Carbon's CDM Monitor (July 2010).

25 EPA (2009)

26 EPA (2010). Differing international offset assumptions account for much of the allowance price range. Notably, avoided deforestation and forest management account for many of international offsets in the model even though these are not currently allowed in CDM.

27 See http://cdm.unfccc.int/Projects/Validation/index.html.

28 The CDM Board charges an administration fee to project developers for project registration. The fee level depends on the size of the GHG reduction project; small projects incur no fee and the largest projects incur a maximum fee of $350,000. The cost of developing small scale project methodologies is also borne by the project developer. Project developers in least-developed countries, however, pay no fees until their first credits are issued.

29 Although Wetzelaer et al. (2007) includes the major categories of transaction costs, other categories could include (for some projects): preparation of a feasibility study, preparations of Emission Reduction Purchase Agreements (ERPAs), selecting and contracting with an auditor, any pre-validation preparation, support for the stakeholder consultation, and engagement with the Designated National Authority (DNA).

30 Estimates do not include forestry projects.

31 The carbon dioxide equivalent for HFC-23 is 11,700 and for N_2O is 310.

32 OQI (2008) and OQI (2009)

33 Gillenwater (2011 forthcoming)

34 ELI (2002) and Hahn and Hester (1989)

35 Trexler et al. (2006)

36 Under CDM, anyone can at any time suggest a new approach to addressing additionality for a specific project type by submitting a proposed new or revised methodology. Further, the Board has issued public calls for suggestions to improve its process for determining additionality on several occasions. The current process reflects input received from those calls.

37 See UN (1998), Kyoto Protocol to the United Nations Framework Convention on Climate Change, Article 12, paragraph 5(c). http://unfccc.int/resource/docs/cop7/13a02.pdf#page=20.

38 Michaelowa (2009)

39 If biomass used for combustion is assumed to be replanted and regrown, in the accounting of CO_2 emissions it can be treated as zero net emissions.

40 In some developing countries, government regulations may rarely, if ever, be enforced, and therefore noncompliance may be the norm. In such cases, the CDM also considers the enforceability of laws and regulations.

41 Such as internal rate of return, net present value, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh or levelized cost of delivered heat in $/GJ).

42 Unfortunately, the requirement for sensitivity analysis has not met expectations for transparency and improvement to the investment analysis tool and other changes are currently under consideration.

43 Essential distinctions may include a significant change in circumstances for the proposed CDM project compared to the circumstances for similar projects. For example, new barriers may have arisen, or promotional policies may have ended or cannot be accessed, leading to a situation in which the proposed CDM project is no longer financially attractive without the incentive provided by the CDM. The change must be verifiable.

44 Another issue is the erroneous rejection of project proposals that are actually additional. Although this problem has less environmental impact, it does reduce the program value for project developers. The inclusion of an appeals process for rejected proposals could help reduce the prevalence of these "false negatives."

45 See UNFCCC (2001), Decision 17/CP.7, paragraph 1

46 This study includes many projects from the initial years of the CDM when project review was less rigorous and rejection rates were lower. Since then, the Board has significantly increased its oversight of the process and rejection rates are now much higher.

47 Flues et al. (2008)

48 IETA (2009) and Schneider (2009)

49 OQI (2009), IETA (2009), Flues et al. (2008), and Schneider (2007)

50 Numerous other improvements have been recommended by various stakeholders, for example see IETA (2009) and Schneider (2009).

51 Schneider (2009) and Castro and Michaelowa (2010)

52 Au Yong (2009)

53 UNFCCC (2008) and UNFCCC (2010c)

54 Schneider et al. (2008)

55 All CDM methodologies are publicly available at: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

56 The CDM is also developing a standardized tool for completing the investment analysis.

57 This CDM methodology panel is also supported by a roster of peer reviewers from around the world who are experts on specific technologies and industries.

58 See UNFCCC (2005b), Decision 3/CMP.1, paragraph 45. "A baseline shall be established…[in] a transparent and conservative manner regarding the choice of approaches, assumptions, methodologies, parameters, data sources, key factors and additionality, and taking into account uncertainty."

59 For example, the Regional Greenhouse Gas Initiative, the Climate Action Reserve, the Voluntary Carbon Standard, and the Gold Standard.

60 See Scott (2008)

61 Because it is project developers who propose new methodologies for quantifying emission reductions, in the early days of the CDM, there were few standardized methodologies available for use, which did increase the costs for project developers to create new methodologies and for the UN to review them.

62 WCI (2010)

63 IETA (2009)

64 In an effort to deal with the expanding number of methodologies, decisions and general guidance documents, a searchable catalog of CDM decisions has now been made available at http://vk.cdmis.net/Reference/catalogue/search.

65 Auditors are also subject to "spot checks" and the Board can suspend an auditor's accreditation upon review.

66 See types of small-scale CDM project activities (SSC) in Glossary of CDM terms at http://cdm.unfccc.int/Reference/glossary.html.

67 Schneider (2007)

68 In November 2008 the CDM Board temporarily suspended the accreditation of one the program's largest auditors, Det Norske Veritas (DNV), for problems with its audit practices. In reviewing the auditor's work, the Board determined that DNV was non-conforming with a number of CDM requirements. The Board suspended another large auditor, SGS, in September 2009 and two more, KEMCO (partial suspension) and TUEV SUED, in March 2010. After corrective actions were taken, DNV's and SGS's accreditations were reinstated in February of 2009 and December 2009, respectively. The Board has also rejected the 2008 reaccreditation application of another auditor, the Japan Consulting Institute.

69 Although project approval time has improved, the length continues to be a deterrent to project investors.

70 Monthly average lag time between the beginning of the 30-day public comment period and request for registration. UNEP Risoe (2010).

71 Such a training requirement could be modeled after the existing UN training program for Expert Review Team members that review national GHG emission inventories submitted under the UNFCCC and the Kyoto Protocol. The Executive Board appears to be moving this direction, as indicated at the 50th meeting of the Board in 2009.

72 In many jurisdictions, CERs are treated as rights sui-generis (quasi-property rights).

73 Training and capacity building support for developing country DNAs could help them better ensure that domestic laws addressing ownership and other issues are fully addressed.

74 Information on the CDM registry is available at http://cdm.unfccc.int/Registry/index.html.

75 CER "recycling" created controversy in Europe in early 2010. Specifically, the practice involved countries swapping for resale CERs surrendered for compliance under the EU's emissions trading scheme for "hot air" emission allowances allocated to former Soviet bloc countries. CERs are viewed as more valuable in the global emissions trading market than these "hot air" allowances. The EU Commission issued rules to avoid this in the future.

76 The project boundary is all sources of GHGs under the control of the project participants that are significant and reasonably attributable to the CDM project.

77 In the climate policy area, the term "leakage" is often used in a variety of ways. In some contexts, it refers to fugitive emissions (e.g., methane releases from natural gas pipelines), in others it may refer to the potential macroeconomic effects of GHG mitigation policy causing a shift in emissions-intensive industries to countries without emission constraints.

78 While an avoided deforestation project is used here for explanatory purpose, they are not currently eligible under CDM. Significant discussion, however, is underway on how to eventually include this type of activity.

79 Under the rules of the CDM, afforestation and reforestation involves the replanting of an area with trees that has been without forest for at least 50 years or since 31 December 1989, respectively. In general, though, afforestation is the process of establishing a forest on land that is not a forest, or has not been a forest for a long time. Reforestation is the restocking of existing forests that have been deforested.

80 UNFCCC (2010b)

81 This supports the assessment that the CDM contributes to technology transfer by lowering several technology-transfer barriers and by raising the transfer quality. See Schneider et al. (2008).

82 See, for example, Pearson (2005).

83 See World Commission on Environment and Development (1987).

84 During the negotiation of the Kyoto Protocol, developing countries insisted that they be given complete discretion on how sustainable development was defined and measured, which effectively determines what is considered as sufficient sustainable development benefits for a project to be approved. DNAs are to evaluate key linkages between national sustainable development goals and CDM projects. As it stands, the definition of sustainable development and how CDM projects should contribute to it is a host country's sovereign decision.

85 Many countries do publish project eligibility guidelines that include some criteria that, a priori, exclude projects that are less likely to deliver domestic sustainable development benefits. But in most cases these guidelines are vague and not stringently applied.

86 Schneider (2007), Sutter and Parreño (2007), Olsen and Fenhann (2008), and Boyd et al. (2009)

87 Schneider (2007)

88 Some countries (e.g., China) are electing to utilize some of the CDM credit revenue from these large industrial projects to reinvest in other activities that do produce more sustainable development benefits.

89 See, for example, Sutter (2007). In addition, efforts like the "Development Dividend" initiative of the International Institute for Sustainable Development (IISD) are seeking ways to maximize the sustainable development benefits of the CDM; see http://www.iisd.org/climate/markets/dividend.asp.

90 See Okubo and Michaelowa (2010) for an analysis of capacity building programs funded by donor countries and institutions.

91 In recognition of the windfall profits involved, the Chinese government has applied a tax (65 percent on industrial HFC and 30 percent on N_2O projects) to the CER income from these projects and has said it will be investing the tax revenue in other sustainable development projects.

92 Wara and Victor (2008)

93 With industrial HFC and N_2O projects, there is little uncertainty regarding the appropriate abatement technology, the cost of abatement, or the emission sources (i.e., a few easily identified large industrial facilities). An international abatement fund could have achieved these emissions reductions at a much lower cost than was the case under CDM.

94 Nonetheless, several HFC-23 projects are currently being investigated by the CDM Board for potentially manipulating production levels (albeit without exceeding historical output) as well as manipulating the efficiency of their process to increase HFC-23 waste gas generation.

95 Wara and Victor (2008), p. 18.

96 See UNFCCC (2005), CDM Executive Board report 22, Annex 3. This decision is referred to as the E+/E– policy and recent actions by the CDM Board with respect to Chinese wind energy projects has led to significant controversy (PDF (2009) and Lewis (2010)).

97 Bloomberg (2010)

98 Business Wire India (2010)

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APPENDIX

Table 1. All CDM projects in Pipeline as of March 2010

Projects	Expected CERs/yr	Number	How the project types are defined
Afforestation/Reforestation	5,084	58	Replanting an area with trees that has been without forest
Agriculture	10	1	Irrigation, alternative fertilizers, rice crop CH_4 (Biogas under methane avoidance)
Biomass energy	53,094	855	New plant using biomass or existing ones changing from fossil to biomass, also biofuels
Cement	8,754	57	Lime in the cement is replaced by other materials, or neutralization with lime is avoided
CO_2 capture	29	3	Recovered CO_2 from tail gas substituting fossil fuels for production of CO_2
Coal bed/mine methane	43,727	77	CH_4 is collected from coal mines or coal beds. This includes Ventilation Air Methane (VAM)
EE Households	1,409	35	Energy Efficiency improvements in domestic houses and appliances
EE Industry	5,602	203	End-use Energy Efficiency improvements in industry
EE own generation	73,878	558	Waste heat or waste gas used for electricity production in industry
EE service	258	27	Energy Efficiency improvements in buildings and appliances
EE Supply side	29,162	86	More efficient power plants producing electricity and district heat, Coal Field Fire Extinguishing
Energy distribution	5,426	18	Reduction in losses in transmission/distribution of electricity/district heat, Country interconnection
Fossil fuel switch	48,792	150	Switch from one fossil fuel to another fossil fuel (including new natural gas power plants)
Fugitive	18,219	45	Recovery instead of flaring of CH_4 from oil wells, gas pipeline leaks, charcoal production, fires in coal piles
Geothermal	3,447	15	Geothermal energy
HFCs	82,498	23	HFC-23 destruction
Hydro	159,773	1523	New hydro power plants
Landfill gas	48,236	320	Collection of landfill gas, composting of MSW, or incinerating of the waste instead of landfilling
Methane avoidance	36,136	696	Projects producing biogas from manure, waste water, industrial waste, palm oil waste, or avoid CH_4 by composting or aerobic treatment
N_2O	50,261	70	N_2O reduction from nitric and adipic acid, production
PFCs and SF_6	4,054	15	Reduction of emissions of PFCs and SF_6
Solar	1,119	48	Solar PV, solar water heating, solar cooking
Tidal	315	1	Tidal power
Transport	2,396	25	More efficient transport
Wind	84,441	967	Wind power
Total	**766,119**	**5876**	

Source: UNEP Risoe (2010)

Table 2. Types of Methodologies Used in the CDM

Sectors covered	Number of projects using the methodology	Number of methodologies
Afforestation & Reforestation	35	12
Biofuels	4	2
Biomass	362	9
Cement	55	4
CO_2 capture	2	2
Coal bed/mine methane	78	2
Energy distribution	14	3
Energy efficiency, Households	20	12
Energy efficiency, own generation (of electricity)	482	6
Energy efficiency, Service	0	1
Energy efficiency, Supply side	79	11
Fossil fuel switch	95	5
Fugitive emission from fuels	39	8
HFCs	20	1
Landfill	227	7
Methane avoidance (Solid waste)	132	8
Methane avoidance (Liquid waste)	70	6
N_2O	76	4
PFCs and SF_6	15	6
Transport	11	2
Zero emission renewables	1552	5
Small scale (including A/R CDM)	3183	55

Source: UNEP Risoe (2010)

This report examines the role of the Clean Development Mechanism as a cost-effective tool in mitigating emissions and reviews the lessons learned, the institutional changes that have been made, and the ongoing challenges it faces. It adds to the Pew Center's work to develop policy solutions to achieve important climate goals that provide flexibility and incentives for innovation. Our goal is to bring a cooperative approach and critical scientific, economic, and technological expertise to the global climate change debate. We inform this debate through wide-ranging analyses in four areas: policy (domestic and international), economics, environment, and solutions.

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